Steel frame shearing apparatus.

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Proprietor: Sango Jyuki Kabushiki Kaisha
6-10-6 Akabane-nishi Kita-ku
Tokyo (JP)

Inventor: Kanno, Samon
4-12-3 Minami-ikebukuro
Toshima-ku Tokyo (JP)
Inventor: Kaneko, Naotomo
41-2 Ooyamakanai-machi
Itabashi-ku Tokyo (JP)
Inventor: Kozaki, Takaharu
1-9-2 Nishigaoka
Kita-ku Tokyo (JP)

Representative: Jackson, David Spence et al
REDDIE & GROSE 16, Theobalds Road
London, WC1X 8PL (GB)

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Description

The invention relates to a steel frame shearing apparatus comprising a pair of opposing side plates, a pair of jaw members pivoted to a pair of main shafts between the side plates, a drive mechanism for causing one or both of the jaw members to perform opening and closing movement, and a pair of shearing blades mounted respectively on the jaw members.

Hitherto, as steel frame shearing apparatus for shearing off shaped steel materials, steel frames in concrete structures and steel body frames when demolishing automobiles, there have been proposed crushing type apparatus in which opposing blades crush and pinch off workpieces, and scissors type apparatus in which opposing shearing blades shear off workpieces. In shearing off workpieces by the use of opposing blades, the opposing blades require a substantial force and the cutting edges of the blades tend to become nicked. Also, since workpieces tend to slip towards the leading ends of the blades, the blades need to have a length sufficient to accommodate the slippage of workpieces. When shearing blades are used to shear off a workpiece of limited thickness, the workpiece is caught in between the shearing blades, but when a workpiece of considerable thickness is to be sheared off, the blades tend to slip laterally from the workpiece so that the apparatus does not shear the workpiece off satisfactorily. Consequently, a shearing apparatus with shearing blades is suitable only for shearing-off workpieces which can be accommodated by the blades and thus, the application and performance of such shearing apparatus are limited. Further, with this type of shearing apparatus, there is also the problem that workpieces slip towards the leading ends of the blades. An example of a shearing apparatus having a single movable blade is described in DE—A—2 722 258.

In FR—A—2 442 685 there is described a scissors type apparatus of the type defined at the beginning and having a third jaw to prevent tilting of the workpiece during shearing. However, this known apparatus does not have means to prevent workpieces from slipping towards the leading ends of the blades.

It is therefore an object of the present invention to provide a steel frame shearing apparatus which can effectively eliminate the drawbacks inherent in the prior art steel frame shearing apparatus referred to hereinabove and which can satisfactorily shear off workpieces having different shapes and dimensions.

According to the present invention, a steel frame shearing apparatus of the type defined at the beginning is characterised by a pair of opposing crushing blades mounted on the leading end side of the jaw members in opposing relationship for locally pinching and crushing a workpiece positioned between the crushing blades in response to the closing movement of the jaw member or members, and in that the two shearing blades are mounted on the base end side of the jaw members in opposing relationship for shearing off the workpiece at a crushed portion of the workpiece in response to the closing movement of the jaw members.

The present invention will now be described in more detail, solely by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a side elevational view of a first embodiment of a steel frame shearing apparatus embodying the present invention, with a portion thereof cut away;

Figs. 2, 3 and 4 are sectional views on an enlarged scale taken along the lines II—II, III—III and IV—IV of Fig. 1, respectively;

Fig. 5A is a sectional view on an enlarged scale showing the crushing operation by the crushing blades;

Figs. 5B and 5C are cross-sectional views on an enlarged scale showing the successive steps in the shearing operation by the shearing blades;

Fig. 6 is a side elevational view of another steel frame shearing apparatus embodying the present invention, with a portion thereof cut away;

Fig. 7 is a cross-sectional view on an enlarged scale taken along the line VII—VII of Fig. 6; and

Fig. 8 is a cross-sectional view of modified means for securing the shearing blades to the jaw members.

Fig. 1 shows a first example of a steel frame shearing apparatus embodying the invention. In Fig. 1, two opposing jaw members 1, 1 are shown pivoted at the base ends 1a, 1a to two main shafts 2, 2 extending between a pair of opposing side plates 3, 3. The side plates 3, 3 are connected together at their leading ends in a predetermined spaced relationship to each other by means of connector bolts 4, 4 and secured at their base ends to a swivel plate 5 which is in turn attached to an end plate 6 for swivel movement about its axis. Secured to the end plate 6 is a bracket member 7 having mounting holes 8a, 8b. The mounting hole 8a in the bracket member 7 has the arm 9 on the boom of a working machine such as a power shovel (not shown) pivoted thereto by means of a pin 10 and pivoted to the mounting hole 8b in the bracket member 7 and the arm 9 by means of pins 13a, 13b, respectively, are connector links 12a, 12b which are in turn pivoted at the other ends to a pin 11b at the leading end of the piston rod 11a of a hydraulic cylinder 11 mounted on the arm 9. As the piston rod 11a extends and retracts, the operating angle of the side plates 3, 3 and accordingly, of the jaw members 1, 1 is set. A drive mechanism 14 is provided below the swivel plate 5 for opening and closing the jaw members 1, 1 and includes an hydraulic cylinder 17. Projections 15, 16 extend from the base ends 1a, 1a of the jaw members 1, 1. The projection 15 is pivoted at the leading end to the cylinder head of the hydraulic cylinder 17 by means of a pin 18 whilst the projection 16 is pivoted at the leading end to the piston rod 17a of the hydraulic cylinder 17 by means of a pin 19. The hydraulic cylinder 17 is supplied with oil under pressure from an oil...
supply source (not shown) through a hose 20 or a hose 21, alternately. When the cylinder 17 is supplied with oil from the supply source through the hose 20, the piston rod 17a is retracted and when the piston rod 17a has retracted completely, the jaw members 1, 1 engage a stop member 22 and are held in their fully open position by the stop member 22 and, on the other hand, when the cylinder 17 is supplied with oil from the supply source through the hose 21, the piston rod 17a extends to move the jaw members 1, 1 to the closed position. Hydraulic couplings 20a and 21a connect the hoses 20 and 21 to separate oil pressure conduits which extend from the oil pressure source. Stop members 22, 23 and 23 are secured to the side plates 3, 3. When the jaw members 1, 1 abut at the shoulders 1b, 1b on their base ends against the opposite end faces 22a, 22a of the stop member 22, the opening position of the jaw members 1, 1 is limited thereby and when the jaw members 1, 1 abut at the shoulders 1c, 1c on their base ends against the adjacent end faces 23a, 23a of the stop members 23, 23, the closing position of the jaw members 1, 1 is limited thereby. The jaw members 1, 1 are provided with arcuate slots 24, 24 through which the above-mentioned connector bolts 4, 4 extend so that the jaw members 1, 1 can open and close without being obstructed by the bolts 4, 4. Two cooperating crushing blades 25, 25 are mounted on the leading end side of the jaw members 1, 1 in opposing relationship for pinching and crushing a workpiece 43 therebetween when the jaw members 1, 1 close. That is, as more clearly shown in Fig. 3, each of the crushing blades 25 is received in a recess 26 formed longitudinally in the opposing face at the leading end portion of the associated jaw member 1 and is held in position by means of a bolt 27. The cutting edge 25a of each crushing blade 25 is formed with an arcuate tip 25a.

Two cooperating shearing blades 28, 28 are mounted on the base end side of the jaw members 1, 1 in opposing relationship for shearing off crushed portions 43a of the workpiece 43 by the closing movement of the jaw members. That is, as is more clearly shown in Fig. 2, the base end portions of the jaw members are formed with blade mounting portions 28b and the shearing blades 28 are secured to the blade mounting portions of the associated jaws by means of bolts 30 so that the blade surfaces 28a of the cutting edges 28a on the two shearing blades 28 are directed in opposite directions. The jaw members 1, 1 are further formed at the leading ends thereof with a pair of projections 31a, 31b extending in opposing relationship to each other as shown in Fig. 4 and projecting inwardly from the cutting edge tips 25a', 25a' on the crushing blades 25, 25. Furthermore, the jaw member 1 is formed with a plurality of through holes 32, 32 extending from the outer surface into the associated recess 26 to receive pusher bars (not shown) which are adapted to push the crushing blade 25 out of the associated recess 26.

With this construction and arrangement, in operation, the piston rod 17a of the hydraulic cylinder 17 is first of all retracted to position the jaw members 1, 1 in the open position as shown by the solid lines in Fig. 1. With the jaw members 1, 1 held in the open position, the arm 9 of the working machine and hydraulic cylinder 11 are manipulated until the workpiece 43 is in the position between the crushing blades 25, 25 shown by the solid line in Fig. 1. Thereafter, the piston rod 17a of the oil cylinder 17 is extended from the retracted position to pivot the jaw members 1, 1 to the closed position as shown by the chain line in Fig. 1 whereby the cutting edge tips 25a', 25a' of the crushing blades 25, 25 pinch and crush the workpiece 43 at selected portions thereof as shown in Fig. 5A. The degree of crushing of the workpiece 43 is limited by the abutment of the base end shoulders 1c, 1c of the jaw members 1, 1 against the adjacent end faces 23a, 23a on the stop members 23, 23. Thereafter, the piston rod 17a of the hydraulic cylinder 17 is retracted to open the jaw members 1, 1 and the working machine arm 9 and hydraulic cylinder 11 are again manipulated until the crushed portions 43a of the workpiece 43 are in the position between the shearing blades 28, 28 shown by the chain line in Fig. 1. Thereafter, the piston rod 17a of the hydraulic cylinder 17 is again extended to close the jaw members 1, 1 as shown by the chain line in Fig. 1 whereby the shearing blades 28, 28 shear off the workpiece 43 at the crushed portions 43a as shown in Figs. 5B, 5C. The closed position of the jaw members 1, 1 is again determined by the end faces 23a, 23a on the stop members 23, 23. When the workpiece 43 is formed of ordinary sheet metal or light weight shaped steel, the workpiece can be directly sheared off by the shearing blades 28, 28 without precrushing by the crushing blades 25, 25.

Thus, according to the present invention, since it is only necessary that the workpiece 43 is initially crushed to a certain degree by the crushing blades 25, 25, no substantial crushing force is required and thus, there is no possibility of blade nicking. Furthermore, as more clearly shown in Fig. 5B, the shearing blades 28, 28 adapted to shear off the crushed portions 43a of the workpiece 43 can be easily and positively set on the crushed portions 43a where the workpiece 43 has a minimum cross-sectional area by the guiding action which results from contact between the tip of the inclined back surfaces 28a' of the shearing blades 28 and the ramps 43b (Fig. 5B) on the workpiece 43. Furthermore, since the minimum cross-sectional area of the crushed portions 43a is cracked or is about to crack under the crushing action of the crushing blades 25, 25, the shearing blades can effectively or easily shear off the workpiece with a small force and at the same time, prevent the workpiece from slipping towards the leading ends of the blades. In addition, since the thickness of the workpiece 43 is locally reduced by the crushing, the workpiece 43 is restrained from rotating (in the counter-clock-
The oil cylinder 34 is supplied with oil under pressure from the oil pressure source via the oil pressure port 34b, 34c or 34c' to thereby extend or retract the piston rods 34a, 34a' in symmetrical relationship at right angles to the center axis X—X'. Since the hydraulic cylinder 34 is not allowed to move in its axial direction, its movement being limited by the grooves 33, 33 in the side plate 3, 3, the jaw members 1, 1 are opened and closed symmetrically with respect to the center axis X—X' by the piston rods 34a, 34a' and do not move unsteadily in any given opening position. Consequently when the jaw members 1, 1 are to be opened, it is not necessary for the jaw members to be opened to their maximum opening so as to abut against the stop member 22 to thereby hold the jaw members in the maximum opening position as described in connection with the first embodiment. Also it is unnecessary to use the stop member 23, 23 employed in the first embodiment to prevent jaw members 1, 1 from moving unsteadily substantially as the jaw members are to be closed. Thus the jaw members 1, 1 can positively grip the workpiece 43 in the center axis X—X' in any given opening position of the jaw members. Especially when the workpiece 43 is of small dimensions, the opening defined by the jaw members can be reduced to accommodate the dimensions of the workpiece to enhance operational efficiency. In addition, there is no possibility that the jaw members abut against the workpiece in asymmetrical relationship with respect to the apparatus such as to produce any unbalanced reaction force which is undesirable for the apparatus. In the example of Fig. 6, the opposing end faces 31a', 31b' on the projections 31a, 31b at the leading ends of the jaw members 1, 1 protruding inwardly from the cutting edge tips 25a', 25a' of the shearing blades 25, 25 and the crushing blades 25, 25 whereby while being crushed by the crushing blades 25, 25 the workpiece 43 abuts against the projections 31a, 31b which in turn restrain the workpiece 43 resulting in an improvement in crushing efficiency. Thus, workpieces having different shapes can be properly and positively crushed. The steel frame shearing apparatus can be applied to the shearing-off of various shaped structural steel workpieces including the illustrated H-section shaped steel workpiece, steel frame workpieces in concrete structures and body frame workpieces for automobiles. Also the projections 31a, 31b can serve as means for gripping the processed workpiece for transporting, lifting and removing the workpiece. In the foregoing example, although both the two jaw members 1, 1 are designed to open and close, an example can be designed such that only one of the jaw members opens and closes, whilst the other jaw member is stationary.

Additionally, in the foregoing example, the stop members 23, 23 may be eliminated if desired and instead the jaw members 1, 1 may abut at their shoulders (the parts are not limited to the shoulders 1c, 1c) against the connector bolts 4, 4 which serve as stop members in such a case.

Furthermore, instead of being mounted on a travelling working machine such as a power shovel or the like the apparatus may be mounted on a stationary pedestal and workpieces to be processed may be fed to the apparatus. In such a case, the operating angle of the jaw members may be set to be constant.

Figs. 6 and 7 show another embodiment of the present invention. In this example, side plates 3, 3 are formed with grooves 33, 33 positioned on the center axis X—X' of the apparatus. Sildably disposed within the grooves 33, 33 are the trunnions 35, 35 of a two-way movable hydraulic cylinder 34. The hydraulic cylinder 34 includes a pair of piston rods 34a, 34a' received in the opposite sides of the cylinder and the piston rods are adapted to extend and retract in symmetrical relationship at right angles to the center axis X—X' of the apparatus. The piston rods 34a, 34a' are pivoted to the projections 15, 16 at the base ends of the jaw members 1, 1 and the cylinder 34 is formed at the central area of its cylindrical wall with an oil pressure port 34b and oil pressure ports 34c, 34c' in the cylindrical wall adjacent to closure plates 34d, 34d' at the opposite ends of the cylindrical wall. The oil pressure ports 34b, 34c, 34c' are connected to the oil pressure source of the working machine through hoses 36, 37, 37', respectively.
groove 38 and by tightening the nut 41a on the bolt 41, the wedge member 40 is forced into the gap between the blade surface 28a' of the shearing blade 28 and the ramp 38b whereby the wedge member 40 urges the shearing blade 28 against the groove side wall 38a due to the inclination of the ramp 38b and more firmly secures the shearing blade 28. This mounting means assures positive securing of the shearing blades which otherwise tend to loosen in shearing operation. When the shearing blade 28 loosen during shearing operation, then without detaching the blade 28 from the jaw member 1, the nuts 39a, 41a are re-tightened from outside to thereby secure the blade in a predetermined proper position on the jaw member.

It will be apparent to those skilled in the art that many changes may be made in the apparatus without departing from the spirit and scope of the claims.

Claims

1. A steel frame shearing apparatus comprising a pair of opposing side plates (3, 3), a pair of jaw members (1, 1) pivoted to a pair of main shafts (2, 2) between the side plates (3, 3), a drive mechanism (14) for causing one or both of the jaw members (1, 1) to perform opening and closing movement, and a pair of shearing blades (28, 28) mounted respectively on the jaw members (1, 1), characterised by a pair of crushing blades (25, 25) mounted on the leading end side of the jaw members (1, 1) in opposing relationship for locally pinching and crushing a workpiece (43) positioned between the crushing blades (25, 25) in response to the closing movement of the jaw member or members (1, 1), and in that the two shearing blades (28, 28) are mounted on the base end side of the jaw members (1, 1) in opposing relationship for shearing off the workpiece (43) at a crushed portion (43a) of the workpiece (43) in response to the closing movement of the jaw member or members (1, 1).

2. A steel frame shearing apparatus according to claim 1, characterised in that a pair of opposing projections (31a, 31b) are formed at the leading ends of the jaw members (1, 1) protruding inwardly from the cutting edge tips (25a', 25a') of the crushing blades (25, 25).

3. A steel frame shearing apparatus according to claim 1 or 2, characterised in that the side plates (3, 3) have grooves (33) in the center line (X, X') of the apparatus, a trunnion pin (35) of a two-way movable hydraulic cylinder (34) is slidably received in the grooves (33), the hydraulic cylinder (34) forms the said drive mechanism (14) and includes a pair of piston rods (34a, 34a') received in the opposite sides of the said cylinder (34) for extending and retracting movement at right angles to the said center line (X, X'), and the piston rods (34a, 34a') are pivoted to projections (15, 16) at the base ends of the jaw members (1, 1).

4. A steel frame shearing apparatus according to any preceding claim, characterised in that each shearing blade (28) is received in a groove (38) provided in the associated jaw member (1) in contact with one of the side walls (38a) defining the groove (38) with one blade surface (28a') of the blade (28) facing the other side wall of the groove (38), a bolt (39) extends transversely from the said one blade surface (28a') of the blade (28) through the blade (28) and the jaw member (1) to its outer surface, a nut (39a) is fastened at the leading end of the said bolt (39), an outwardly declining ramp (38b) is formed on the other side wall of the groove (38), a wedge member (40) is interposed between the one blade surface (28a') of the blade and the ramp (38b), a longitudinal through hole (40a) is formed in the wedge member (40), a bolt (41) extends through the hole (40a) in the wedge member (40) into a groove (42) formed in the jaw member (1) on the side opposite from the side thereof in which said first-mentioned groove (38) is formed, and a nut (41a) is fastened at the leading end of the last said bolt (41).

Patentansprüche

1. Abschervorrichtung für Stahlrahmen mit einem Paar einander gegenüberliegender Seitenplatten (3, 3), einem Paar Backenglieder (1, 1), die an einem Paar Hauptwellen (2, 2) zwischen den Seitenplatten (3, 3) angelenkt sind, einem Antriebsmechanismus (14), der eines oder beide der Backenglieder (1, 1) zu einer Öffnungs- und Schließbewegung veranlaßt, und einem Paar Scherklingen (28, 28), die jeweils an den Backengliedern (1, 1) angebracht sind, gekennzeichnet durch ein Paar Quetschklingen (25, 25), die an der Seite des führenden Endes der Backenglieder (1, 1) einander gegenüberliegend angedeutet sind, daß sie ein zwischen die Quetschklingen (25, 25) eingebrachtes Werkstück (43) in Abhängigkeit von der Schließbewegung des Backengliedes oder der Backenglieder (1, 1) örtlich einklemmen und quetschen, und daß die beiden Scherklingen (28, 28) an der Seite des Basisendes des Backengliedes (1, 1) einander gegenüberliegend angeordnet sind, daß sie das Werkstück (43) in Abhängigkeit von der Schließbewegung des Backengliedes oder der Backenglieder (1, 1) an einem zusammengequetschten Bereich (43a) des Werkstücks (43) abscheren.

2. Abschervorrichtung für Stahlrahmen nach Anspruch 1, dadurch gekennzeichnet, daß an den führenden Enden der Backenglieder (1, 1) ein Paar einander gegenüberliegender Vorsprünge (31a, 31b) ausgebildet ist, die von den Schneidkantenspitzen (25a', 25a'), der Quetschklingen (25, 25) nach innen vorstehen.

3. Abschervorrichtung für Stahlrahmen nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Seitenplatten (3, 3) in der Mittellinie (X, X') der Vorrichtung Nuten (33) aufweisen, daß in den Nuten ein Lagerzapfen (35) eines beweglichen hydraulischen Zweigezyinders (34) gleitend aufgenommen ist, daß der Hydraulikzylinder (34)
den Antriebsmechanismus (14) bildet und ein Paar Kolbenstangen (34a, 34a') umfaßt, die in den entgegengesetzten Seiten des Zylinders (34) zur Ausfahrt- und Einziehreibung rechtwinklig zur Mittellinie (X, X') aufgenommen sind, und daß die Kolbenstangen (34a, 34a') an Vorsprenen (15, 16) an den Basisenden der Backenglieder (1, 1) angenelkt sind.

4. Abscherrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß jede Scherklinge (28) in einer Nut (38) in dem zugehörigen Backenglied (1) in Berührung mit einer der die Nut (38) begrenzenden Seitenwände (38a) aufgenommen ist, wobei eine Klingenoberfläche (28a') der Klinge (28) durch die Klinge (28) und das Backenglied (1) bis zur äußeren Oberfläche desselben erstreckt, daß am führenden Ende des Schraubbolzens (39) eine Klingenoberfläche (28a') der Klinge (28) ein Schraubbolzen (39) durch die Klingen (28) und die Backenglieder (1) bis zur äußeren Oberfläche desselben erstreckt, daß am führenden Ende des letzgenannten Schraubbolzens (39) eine Mutter (39a) befestigt ist, daß an der anderen Seitenwand der Nut (38) eine nach außen abfallende Rampe (38b) gebildet ist, daß zwischen die eine Klingenoberfläche (28a') der Klinge und die Rampe (38b) ein Keilglied (40) eingefügt ist, daß in dem Keilglied (40) ein längs verlaufendes Durchgangsloch (40a) gebildet ist, der durch das Loch (40a) im Keilglied (40) ein Schraubbolzen (41) in eine Nut (42) erstreckt, die, um dem Klingenende (1) an derjenigen Seite ausgebildet ist, welche der Seite desselben gegenüberliegt, in der die zuerst genannte Nut (38) ausgebildet ist, und daß am führenden Ende des letzigen Schraubbolzens (41) eine Mutter (41a) befestigt ist.

**Revendications**

1. Dispositif pour cisailier des cadres en acier selon la revendication 1 ou 2, caractérisé en ce que les plaques latérales (3, 3) comportent des rainures (33) dans l'axe géométrique central (X, X') de l'appareil, une goupille de tourillon (35) d'un vérin hydraulique (34) mobile dans deux directions est logée de façon coulissante dans les rainures (33), le vérin hydraulique (34) forme le mécanisme d'entraînement (14) et comprend une paire de tiges de piston (34a, 34a') logées dans les côtés opposés dudit vérin (34) pour le mouvement de rentrée et de sortie à angle droit par rapport à l'axe géométrique central (X, X'), et les tiges de piston (34a, 34a') sont mises en pivote ment par rapport aux saillies (15, 16) sur les extrémités d'embase des éléments de mâchoire (1, 1).

2. Dispositif pour cisailier des cadres en acier selon la revendication 1, caractérisé en ce qu'une paire de saillies opposées (31a, 31b) sont formées sur les extrémités d'attaque des éléments de mâchoire (1, 1) faisant saillie vers l'intérieur a partir des pointes de bord de coupe (25a', 25a') des lames d'écrasement (25, 25).

3. Dispositif pour cisailier des cadres en acier selon la revendication 1 ou 2, caractérisé en ce que les plaques latérales (3, 3) comportent des rainures (33) dans l'axe géométrique central (X, X') de l'appareil, une goupille de tourillon (35) d'un vérin hydraulique (34) mobile dans deux directions est logée de façon coulissante dans les rainures (33), le vérin hydraulique (34) forme le mécanisme d'entraînement (14) et comprend une paire de tiges de piston (34a, 34a') logées dans les côtés opposés dudit vérin (34) pour le mouvement de rentrée et de sortie à angle droit par rapport à l'axe géométrique central (X, X'), et les tiges de piston (34a, 34a') sont mises en pivote ment par rapport aux saillies (15, 16) sur les extrémités d'embase des éléments de mâchoire (1, 1).

4. Dispositif pour cisailier des cadres en acier selon l'une quelconque des précédentes revendications, caractérisé en ce que chaque lame de cisaillement (28) est logée dans une rainure (38) prévue dans l'élément de mâchoire associé (1) en contact avec l'une des parois latérales (38a) définissant la rainure (38) avec une surface de lame (28a') de la lame (28) faisant face à l'autre paroi latérale de la rainure (38), un boulon (39) s'étend transversalement à partir d'une surface de lame (28a') de la lame (28) par la lame (28) et l'élément de mâchoire (1) par rapport à sa surface extérieure, un écrou (39a) est fixé au niveau de l'extrémité d'attaque du boulon (39), une rampe s'inclinant vers l'extérieur (38b) est formée sur l'autre paroi d'extrémité de la rainure (38), un élément en forme de coin (40) est interposé entre l'une des surfaces de lame (28a') de la lame et la rampe (38b), un boulon (41) s'étend à travers le trou (40a) dans l'élément en forme de coin (40) jusqu'à dans une rainure (42) formée dans l'élément de mâchoire (1) sur le côté opposé au côté dans lequel est formée la rainure (38) mentionnée en premier et un écrou (41a) est fixé au niveau de l'extrémité d'attaque du boulon (41) mentionné en dernier.